
BURNT CLAY
PRODUCTS
IN FIRE
AND
EARTHQUAKE
GRANT '07

Second Edition, Enlarged

Burnt Clay Products in Fire and Earthquake

"The Truth hurts no Sound,
Reliable Material"

Issued by the Manufacturers of Burnt Clay Products

Brick Construction Association

707 Lankershim Building, Los Angeles, Cal.

Foreword

Since the San Francisco earthquake and fire, there has been no subject of greater importance to all interested in the construction of buildings than the comparative merits of Brick, Tile, Concrete, Reinforced Concrete, Steel and other building materials.

That catastrophe created new problems and presented new conditions. Certain interests have taken advantage of the changed aspect to set forth theories and statements neither fair, honest nor truthful, selfishly attacking brick as a building material.

The truth hurts no sound, reliable article. Brick stands staunchly and safely on its own merits. The cement interests have been active in filling the magazines and the daily press with technical papers by their own engineers and writers, exalting their own product and belittling brick and other materials.

In order to correct any possible misapprehension in the minds of the building public, the manufacturers of Burnt Clay products in Los Angeles and vicinity and the Pacific Coast here present indisputable evidence of the reliability and superior character of Brick as a building material and—under honest and intelligent construction—of its ability successfully to endure even such a tremendous, appalling test as the San Francisco calamity.

Actual photographs do not lie. The accompanying illustrations and explanations show many things of great value. Not only are the good qualities of Brick shown, but the defects of Brick, Stone, Concrete, Reinforced Concrete and frame construction are also presented.

Whatever the defects of Concrete may be, we are making no war on that material; the facts speak eloquently enough. We simply ask that the truth be known.

Significant Extracts The San Francisco Calamity

REPORT OF INVESTIGATIONS MADE BY F. W. FITZPATRICK, EXECUTIVE OFFICER OF THE INTERNATIONAL SOCIETY OF BUILDING COMMISSIONERS, ON BEHALF OF THAT SOCIETY, THE UNITED STATES GOVERNMENT, MANY TECHNICAL JOURNALS, ETC.

THE SITUATION AFTER THE FIRE.

To one skilled in building there were no surprises as to the behavior of different modes of construction under stress of quake and fire, save one, and it was that, knowing the general character of the work in the city, the principal buildings stood as well as they did. Quake and fire have uncovered and left bare all the signs of ignorance, the shoddyism, the petty pilferings practiced in building. The architects who didn't know how their work was done now have a chance to study its inmost secrets in all their ugly nakedness. Will they profit by the lesson?

Many materials and varying qualities of each were used in San Francisco. . . . As a matter of fact, an unbiased and dispassionate examination of the entire fire results, a comparing of the two modes of fireproofing where they were relatively well applied, and where they received anything like the same test in fire, will leave no doubt in one's mind but that tile, even only fairly well applied, is vastly superior and behaved infinitely better under stress than did the concrete work, which, after all, is but an artificial stone, and therefore subject to all the vicissitudes that attend the latter when exposed to fire. . . .

Incident to this concrete craze, people often ask me why it is that it has struck such a vogue, particularly among the younger and less experienced structural engineers in the country. Anything in an experimental stage is bound to be attractive to such young engineers, and the whole subject of reinforced concrete is. I admit, a most fascinating one about which to theorize. The greatest trouble with it generally is to apply those theories in actual construction, and there, of course, is the scene of its failures. To my mind, however, the principal reason for this, at least, temporary popularity is the extreme activity of the exploiters of its hundred or more differing systems. Anything that makes a great noise and is being much fought over and talked about is bound to attain some popularity. Thus, with concrete, the technical journals are overloaded with very scientific discussions as to its modules of elasticity, whether it ought to be wet or dry, etc., etc., and the manufacturers and patentees of the various systems keep all the technical schools and engineering colleges loaded up with tests, reports and what not, concerning their varied products. Naturally enough the colleges turn their attention to the subject, learned professors do some experimenting on their own account on a small scale, and proclaim to the world that thus is so and must remain so under every circumstance, and young and enthusiastic concrete engineers are being developed at the rate of several score a week. . . .

In connection with a comparison of materials and cost, it may not be amiss to add that as far as reinforced concrete and tile are concerned, that in respect to the cheapness of the former method, a floor of well-reinforced, good concrete cannot be made cheaper than tile. When concrete is cheap it must be "cheap" in every sense of the term. Inferior material, the least quantity possible of that, and cheap, unskilled labor, are the constituent elements of its cheapness, and with those three factors what can be expected of the concrete? . . .

CONCLUSIONS.

The same man who builds in San Francisco will also have observed that as far as earthquake is concerned it would hardly seem possible that a more severe shock than that of last April could occur without the complete annihilation of the city and the utter destruction of everything produced or assembled by human hands. He will note that height of building contributed little to the damage thereof; it will be evident to him that a good steel frame most thoroughly braced and upon a sound foundation, and with all else well done, and well tied to that frame, the quake damage occasioned was but trivial. And with this experience in mind that little is easily preventable. Therefore the one great step to take is for him to make his building absolutely fireproof. There is nothing occult or mysterious about perfect fireproofing of buildings. It is a known, tangible, really a

simple science. There have been some perfect buildings erected; why, even in San Francisco there have been features enough about the several structures that, if assembled in one building, would make that an ideal building. . . .

Fill in the voids of your columns with brick.

Fill your floor spans with deep, flat arches of porous tile, the deeper the better; or, if great weight is no disadvantage, then use deep arches of concrete, but let there be a tile-protecting ceiling surface to the latter, or well below the arches a suspended ceiling of metal lath and plaster. In every case have the soffits and projecting members of your floor frame covered with fireproof tile of two thicknesses. Build your outer walls from story to story of brick or concrete, but face it internally with hollow brick and externally with a good quality of well-burned brick. Where ornament is desired, use well-made terra cotta. Don't be afraid of the quantity of the material; it is only the thin, sharp angles, and uneven, poorly baked surfaces that scabble off in a fire. With an even thickness in ornament and plain, plenty of ribs, and properly burned, terra cotta will stand any fire you expose it to. The use of granite, stone and marble, wherever fire can get at them, will hardly be looked upon with much favor by San Franciscans. Use good cement mortar in your walls. Tie them and bond them thoroughly and make them close kin to the frame, not mere distant relatives. Don't be afraid of using plenty of steel in your terra cotta cornices, tie them in, anchor them, and make them part of your building, not merely an easily dislodged, removable lid. . . .

In all that great city there were thirty buildings whose designers knew enough to at least attempt the fireproofing of one feature, the structural steel portion of those buildings; one other designer knew enough to use metallic trim in his building; and there was still another who, though he designed an obsolete and useless form of general construction, knew enough to protect his building externally with wire glass. Now, surely there must be one man there who, in the new city, will give us one building embodying all those good features; one building that is really fireproof and that will stand to point the way, the directions, the means, the manner, of constructing other buildings, after the next great conflagration will have still further accentuated the lessons so forcefully expounded in the greatest of modern conflagrations, the destruction of our western metropolis, San Francisco, once known as "the magnificent."

Fireproof Magazine

Good Brick Work

Brick Residences, Pacific Avenue, San Francisco.

The Brick walls of these buildings were undamaged by earthquake—escaped fire.

Report of Dr. Nakamura on the San Francisco Calamity

"Dishonest Mortar—Faulty Construction"

"Dishonest mortar—corrupt conglomeration of sea sand and lime—was responsible for nearly all of the earthquake damage in San Francisco," says Dr. T. Nakamura, professor of architecture of the Imperial University of Tokio, and one of the most distinguished members of the committee dispatched to San Francisco by the Japanese government to investigate the effects of temblor and fire.

After his investigations, covering a period of weeks, Dr. Nakamura completed his labors, and will report his conclusions to his government.

"I find," said Dr. Nakamura, "that much of the damage to San Francisco from the earthquake was due to poor mortar and faulty construction. . . .

"It is an easy matter, I have found, to design a building that will be not only earthquake proof, but practically fireproof.

". . . brick buildings . . . are largely employed in Japan, where earthquakes of greater severity than the one experienced in San Francisco are not uncommon. The secret of their success, however, lies in the fact that good mortar is used."

"The mortar should either be composed of one part cement to two parts of sand, or of one part of cement, three of lime and five of sand. The brick should be thoroughly wet before being laid, and when the mortar has set under these conditions, a wall becomes practically like solid stone."

Palace Hotel

Showing Monadnock and Call buildings to the right.

This building was 150 feet high, of old-style true and tried brick construction throughout. Foundations, exterior and all interior walls were of brick; floors, windows and doors being of wood.

The building stood on filled ground, and there was no structure in San Francisco the walls of which stood a more severe test, from both earthquake and fire, than this. While it swayed and bent with the force of the earthquake, it regained its former position without a single crack from the vibrations.

Fire a few hours later destroyed the interior, leaving the walls standing in perfect condition, a monument to GOOD brick work.

A Remarkable Incident

This three-story brick building was in the Mission district, and was erected on filled ground.

The quake opened a crack in the ground passing entirely under the building, which, on account of the excellent brick-work, remained unharmed. Interior of the building was later destroyed by fire.

St. Francis Church

Brick. Erected in the fifties. Passed through two fires and earthquakes. Note perfect condition of brick walls, and compare with stone basement.

Basement Walls of St. Francis Church

Showing the effect of fire upon stone and brick.

Many interesting lessons can be learned from this picture. The same quality of stone that was used in this building is today considered one of the best of the aggregate for concrete.

What can be expected as a fire resistant from concrete, three-fourths of which is composed of this material.

Compare effects of fire upon brick and stone.

Fairmont Hotel—Uncompleted when Damaged

Showing by the unburned wood in window openings that only a low degree of heat is necessary to destroy granite. Note perfect condition of terra cotta on the second story, above the granite.

San Marco Apartments

Brick and terra cotta versus granite. Compare action of fire.

Alexander Hotel

Showing excellent condition of brick work after earthquake and fire.

This building, on Geary street, west of Powell, is eleven stories high, ten of which are only 12-inch walls. It probably withstood the hottest fire in San Francisco, being next door to the San Francisco News Company's building, which was filled with magazines and periodicals.

Good construction and honest workmanship. M. J. Lyon, architect; R. Ringrose, contractor.

Light Court, St. Francis Hotel

Poorly constructed brickwork.

Owing to the absence of solid headers, or any form of bond, the pressed brick veneering on the wall was thrown off.

The same condition occurred in many instances where brick walls were erected in this manner.

Fontana Warehouse

Near the Presidio, taken after the earthquake. A picture that speaks for itself. Refugees' camp in the foreground.

Attention is called to the roof construction. Practically no damage was done to any brick building in San Francisco having this hip roof construction.

St. Ignatius—Brick Church

After fire and earthquake. Note excellent condition of brick walls, which had been honestly built. (See dome of city hall at the right of picture.—Dishonest brick work.) Now compare the condition of the brick walls with the concrete steps in front of the building, which crumbled through the action of fire.

The City Hall

This building cost millions of money, and was undoubtedly the plaything of grafters. Even in the parts not burned the concrete is so poor you can kick it out of place; and where fire touched it at all, all life is extinct and you can shake an entire section by walking across it. . . . Here and there are slight evidences of good workmanship; one might almost call them spasms of virtue in careful superintendence. Where the brickwork was well bonded and good cement mortar used, it held so well that though thrown out of place or carried out by the wreckage there are great chunks here and there, four-foot and five-foot cubes, as homogeneous and solid as any rock.

F. W. Fitzpatrick, in *Fireproof Magazine.*

Flood Building

Steel Frame. Condition after fire and earthquake.

Brick Residence in San Francisco
after the Earthquake and Fire

Not a dollar's worth of damage was done to brick walls.

Presidio

The brick barracks of the government buildings were uninjured by the quake, although at this point it was most severe. Note hip roof. Buildings of this class with a hip roof generally escaped without damage.

Temple Emanu-El

Honest brick work and competent designers.

St. Mary's Church, Erected 1854

This building has suffered two earthquakes and two fires. Note substantial manner of construction, which shows honest brickwork.

Mills Building—Steel Frame

Showing the excellent condition of the tile floors after the fire and quake.

Brick Building, San Jose
In perfect condition.

Brick Building, San Jose
After quake. Good brick work.

Public Building, San Jose

Old style brick construction. Though the earthquake shock was extremely severe, all of this class of brick buildings were practically unharmed.

Frame Buildings

Showing effect of the earthquake on frame buildings about 15 years old, due no doubt to the rusting of nails, which allowed the bracings to slip.

Southwest Corner Jackson and Sansome Streets

This row of brick buildings on the southwest corner of Jackson and Sansome streets, was erected in the early sixties. Old style construction, with good, heavy brick partitions, which held in time of need. The vibrations at this point were very severe, but good brick construction withstood them.

THE TITLE TO THIS PICTURE BELONGS TO THE PICTURE ON THE OPPOSITE PAGE & VICE VERSA.
THIS IS THE SOUTH SIDE OF JACKSON STREET LOOKING WEST TOWARD MONTGOMERY FROM SANSOME ST. THE BUILDING AT THE LEFT IS NO LONGER THERE. THE OTHER BUILDINGS ARE IN USE TODAY.

Jackson Street, between Sansome and Montgomery

The buildings are of the same style of construction as those shown in the preceding picture. They received the full force of the shocks, but escaped the ravages of fire. Note perfect condition.

THIS IS THE WEST SIDE OF SANSOME STREET LOOKING SOUTH BETWEEN JACKSON AND WASHINGTON STREETS. BUILDING ON RIGHT GONE, NOW PARKING LOT. THREE STORY BUILDING WITH AWNING GONE. NOW SITE OF STANDARD OIL STATION.

Brick Residence, San Francisco

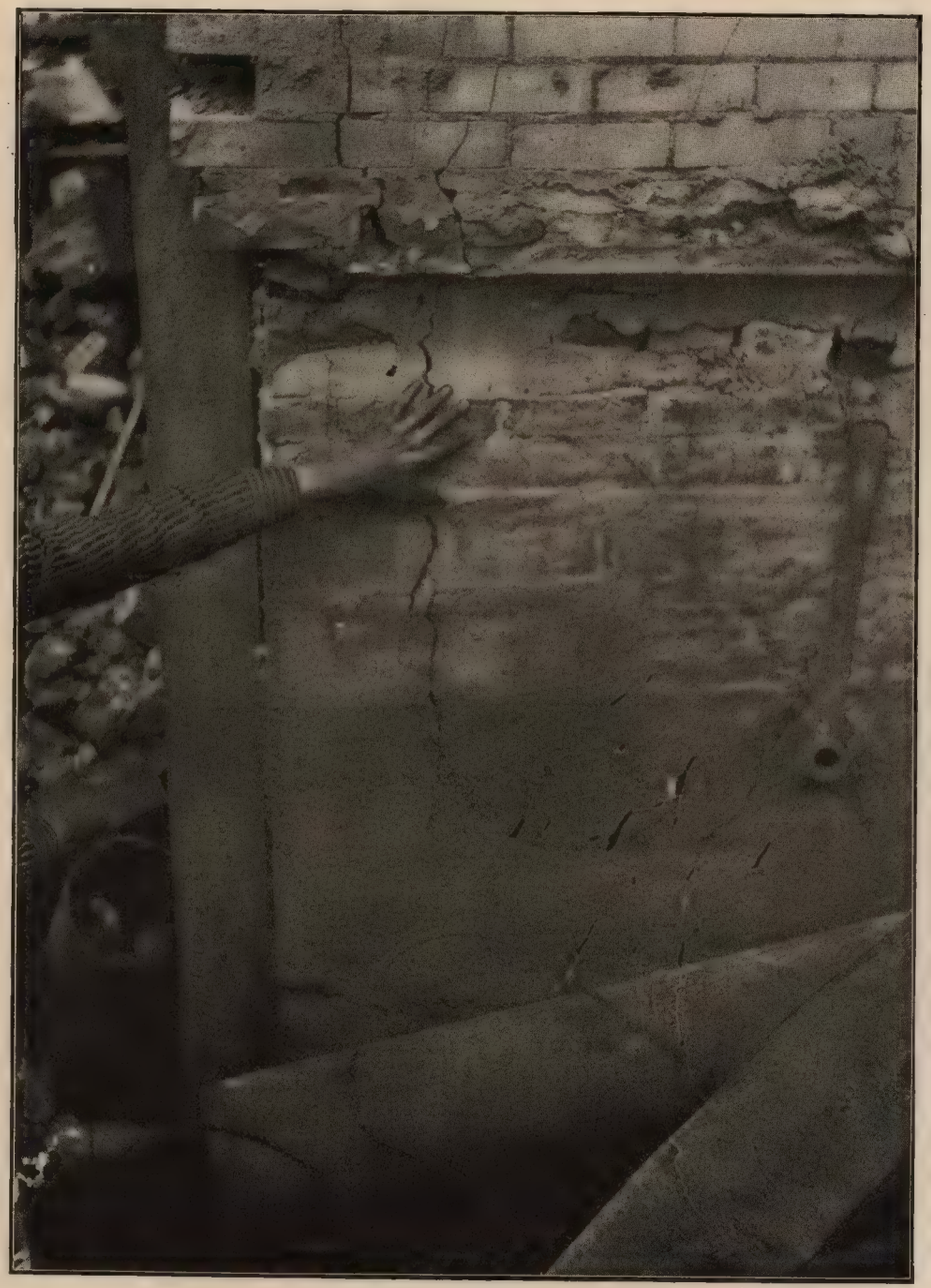
After earthquake and fire. Results of good brick construction. No damage was done to brick walls.

Cathedral at Van Ness Ave. and O'Farrel St. Brick Building

Practically uninjured by the earthquake; a monument to the good judgment of its builders. The building caught fire in the tower. The only effect of the quake was a crack over a window.

Concrete Pier

This pier is typical of many others, showing the manner in which concrete breaks and spalls off. It acts very similarly to granite, under fire.



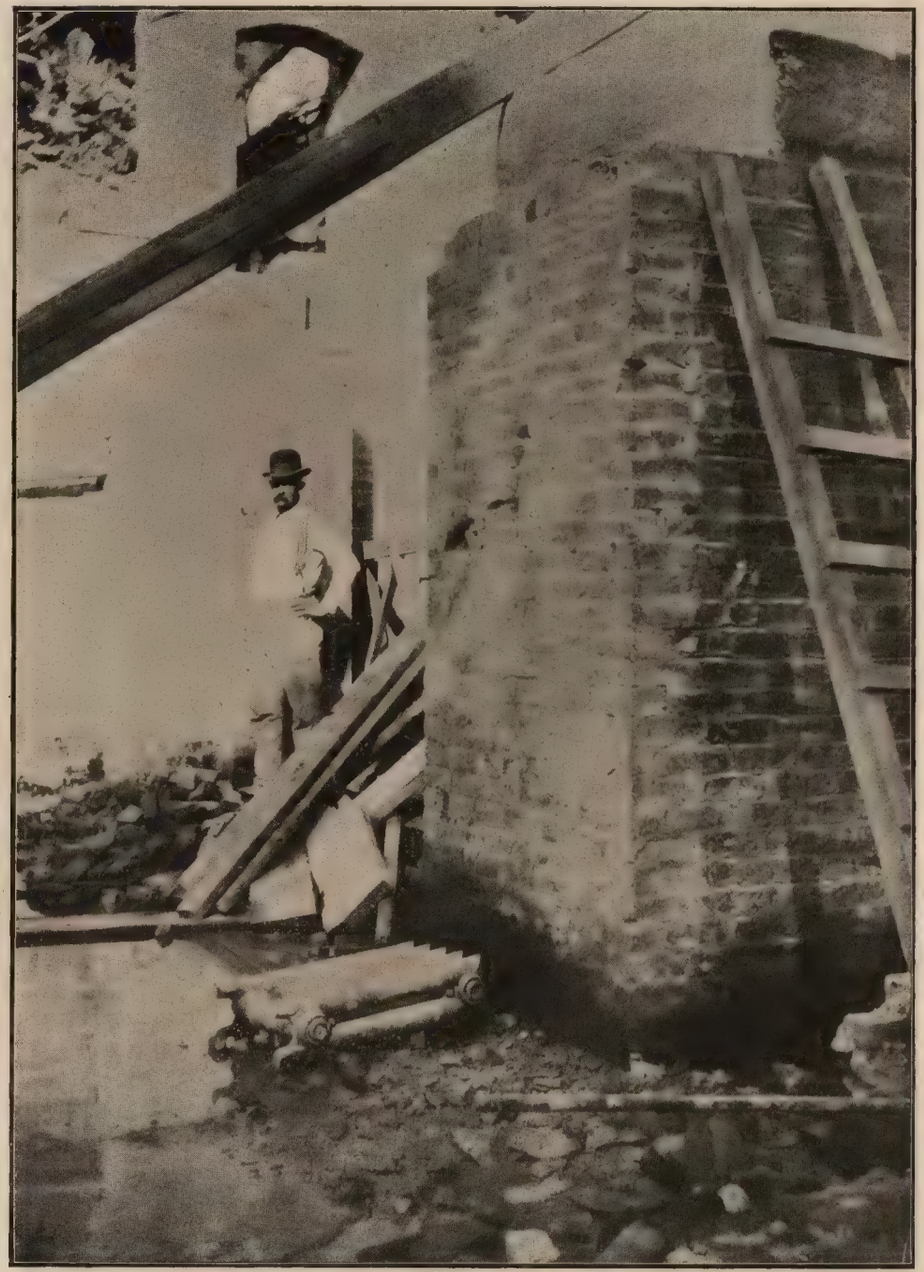
Monadnock Building

Corner pier, showing effect of quake and fire on concrete and sand-lime brick. Effect of fire on sand-lime brick was the same as on any common lime mortar.

Brick Pier

Showing excellent condition after earthquake and fire.

Note manner in which the granite cap has spalled off through the action of fire while brick are unharmed.



Concrete Piers

Same locality and under same conditions as brick piers shown on preceding page. Note spalling, also cracks. The life, or strength, of the concrete was destroyed by the action of fire. Large pieces could easily be knocked from the piers.

Concrete Roof, Crocker Building

Concrete Roof, Scott Building

The concrete shown in this picture collapsed from vibrations of earthquake. It was afterward disintegrated by fire, so that it could easily be crushed into dust.

Concrete Roof, Wells-Fargo Building

Grant School, San Jose

Frame construction. A total collapse.

The earthquake came early in the morning, before the building was occupied. If it had occurred during school hours, hundreds of children probably would have been killed or injured.

Valencia Street, San Francisco

Recovering the dead and injured from frame buildings. Approximately 95 per cent of the loss of life was due to the collapse of this form of building. Fire, to be seen in the background, a few hours later wiped out the buildings shown.

Frame Collapse

Hotel Vendome annex, San Jose. This building was erected on a flimsy wooden foundation, and simply fell over when the shock came.

Hollow Concrete Blocks

Two-story hollow-block building in Palo Alto. The entire outer walls of this building, which were constructed of concrete hollow blocks, were leveled to the ground, the blocks themselves being broken into small pieces.

Concrete Blocks—an Object Lesson.

Erected on North Fair Oaks Avenue, Pasadena, Cal. The owner, a small merchant who had little experience in the building line, desired to erect a building for his own use.

He consulted contractors for brick work, but later on cement hollow block men convinced him that it would be much cheaper and better owing to the superiority of cement over brick to construct his building of hollow blocks.

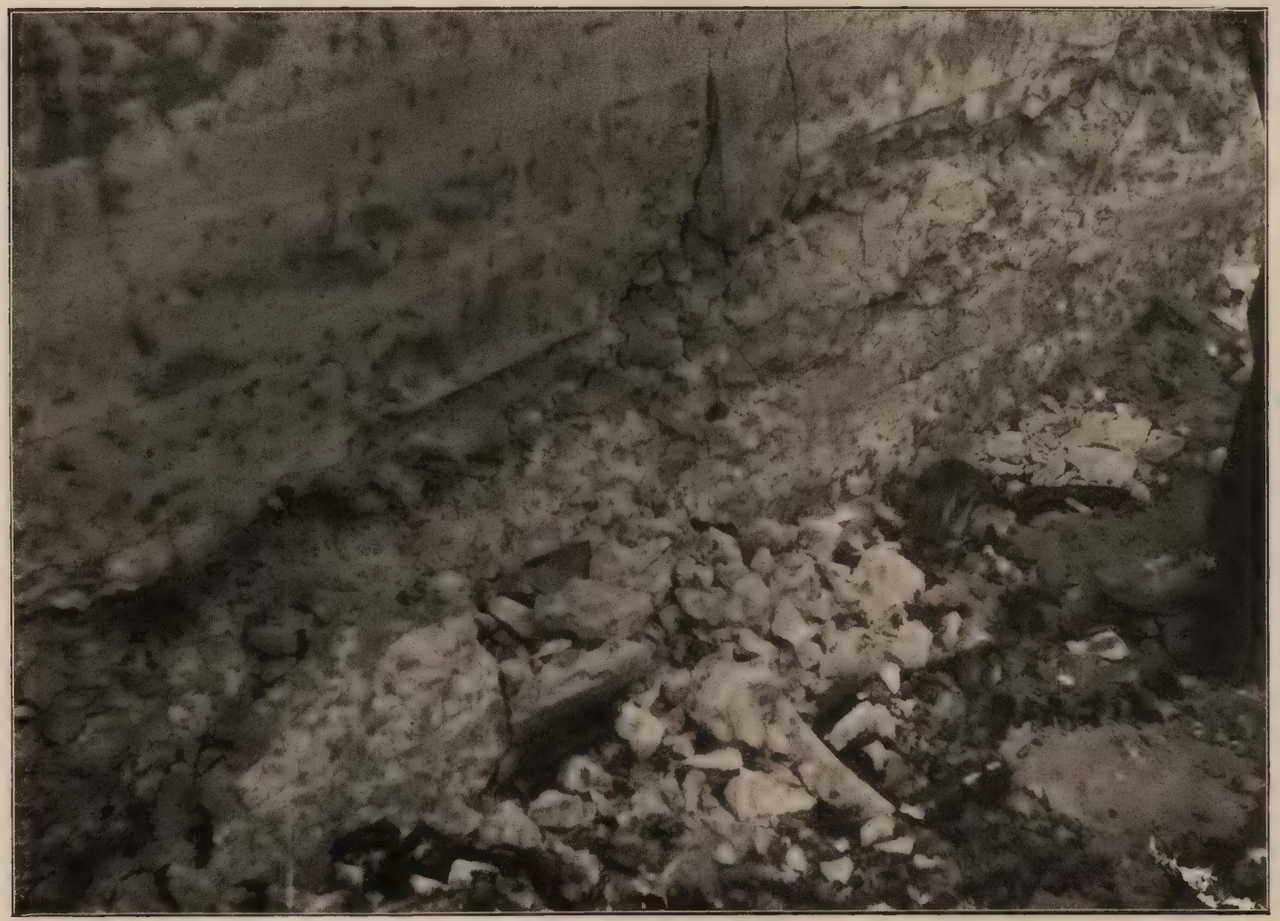
The result in this case was that after the building had been completed and occupied a short time, cracks began to appear in walls and blocks showed signs of crumbling. Efforts were made to repair structure by filling hollow spaces in blocks with cement.

Ultimately building was condemned and torn down. A complete loss to owner.

Cement Blocks, Total Failure

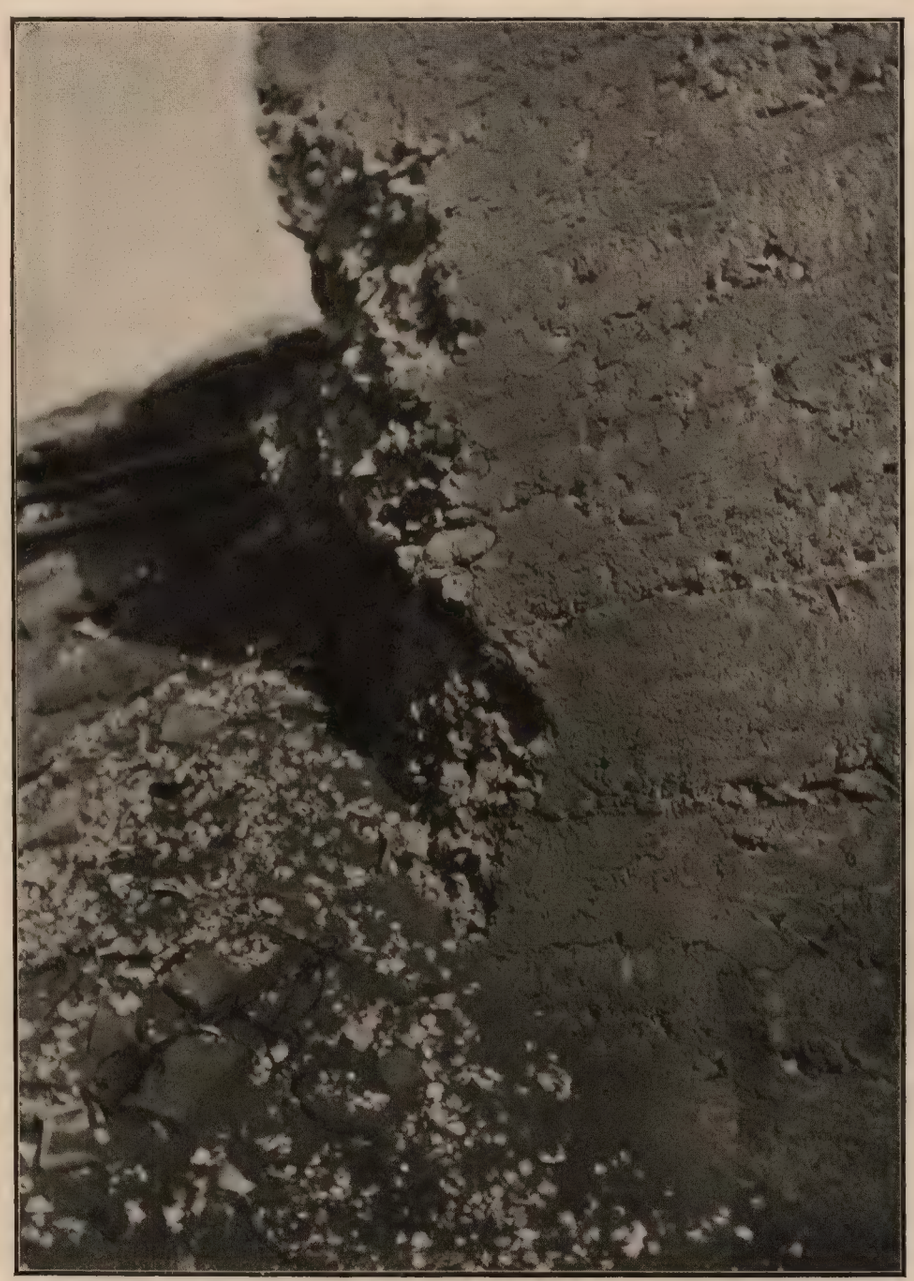
Dehydrated or Burned Concrete in Basement Wall

Showing typical crack that appeared through shrinkage of cement or action of the quake.



Effect of Earthquake on Concrete Foundation

Showing failure of same near bottom. Note large inverted V-shaped piece that had been forced out, causing wall to shift out of plumb. A study of this picture is very important.



Effect of Fire and Water on Concrete Wall

Fire had heated this wall, water had come in contact with it, and in a manner it slacked, like lime, and crumbled.

Concrete Foundation

Showing effect of earthquake and fire.

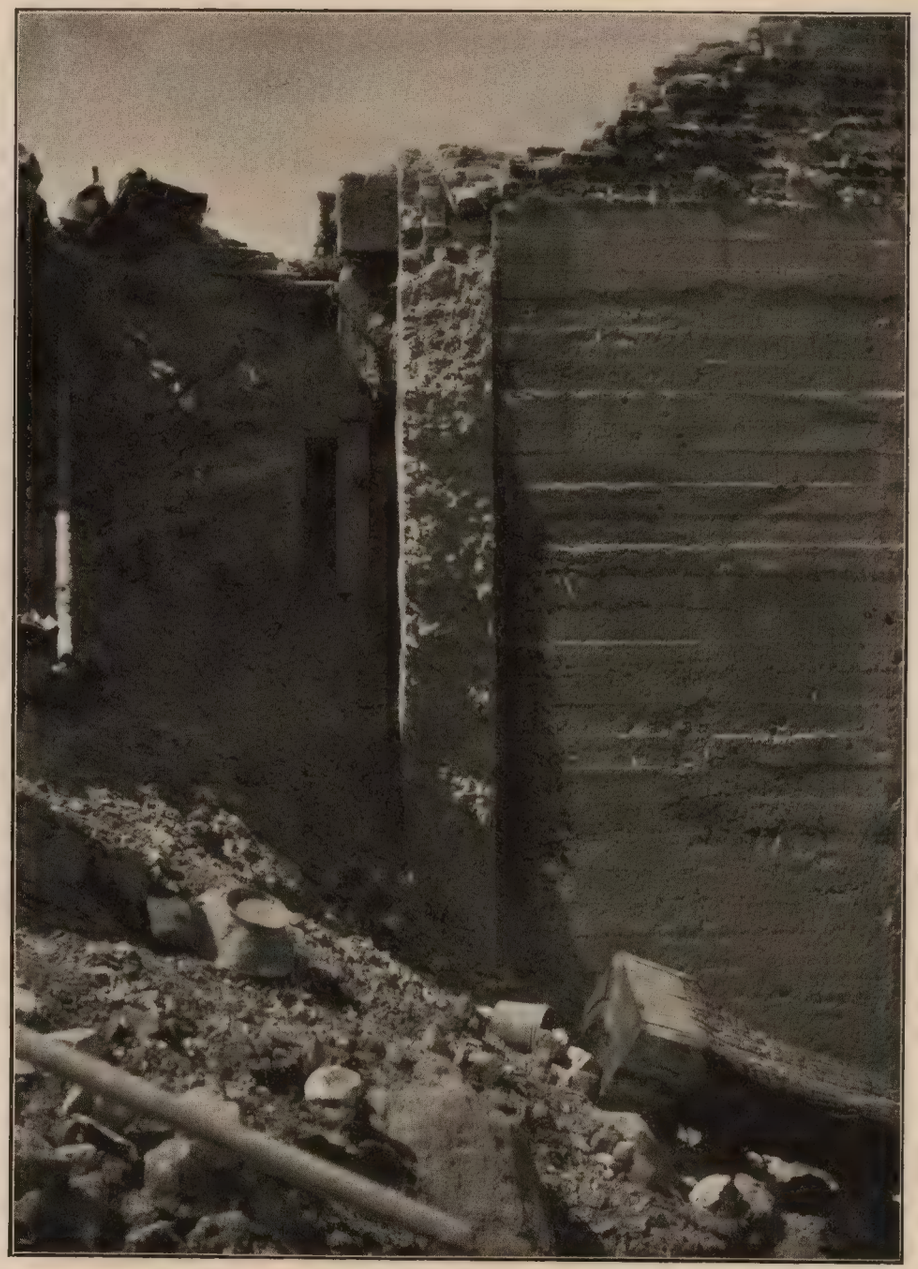
St. Francis Hotel

Showing earthquake crack in heavy concrete foundation in rear part of building; also destruction of concrete floors.

Chinese Bazaar Building

Corner California and Dupont.

Shows collapse of concrete foundation wall, fire having destroyed original strength of the concrete.



Chinese Bazaar Building

Same as preceding picture. Showing basement where entire thickness of concrete wall was dehydrated, or burnt, by fire.

Picture shows person in act of crushing concrete with a piece of ordinary brick, which had also passed through the fire.

"Cement under temperature of from 600 degrees up, loses its waters of crystallization until finally the water will be driven off; the cement or concrete will lose most of its strength, in fact will be ruined."

Capt. John Stephen Sewell, Corps of Engineers, U.S.A.

Globe Mills after Fire and Earthquake

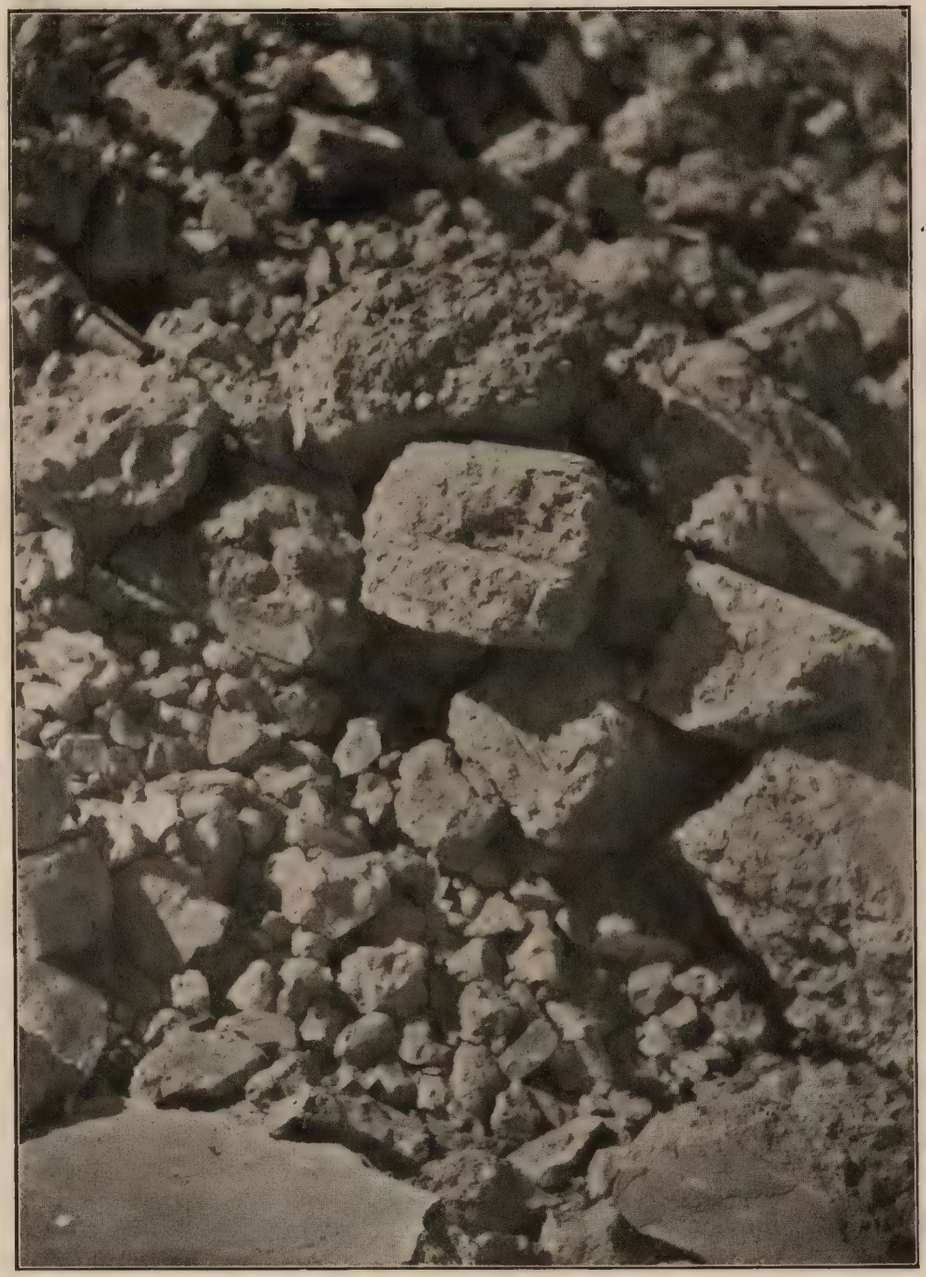
The building here shown is the main building of the Globe Mills, and is of all brick construction. Note its excellent condition, also pile of twisted iron and collapsed concrete annex in the left-hand corner.

Globe Mills, Concrete Annex, Total Collapse

This was an addition to brick building, concrete side walls and reinforced concrete floors and roof. Note breaking points in the concrete wall.

Concrete

That had been removed from destroyed building on Francisco street, between Powell and Mason. Next picture shows camera at closer range.



Pile of Reinforced Concrete

Camera at close range on heap of reinforced concrete shown in preceding picture. Note imprints of twisted iron bars that had been used as reinforcements.

Concrete Observatory

This building was constructed entirely of concrete and steel bars. It was standing practically on a solid rock foundation, on what is known as Strawberry Hill, Golden Gate Park.

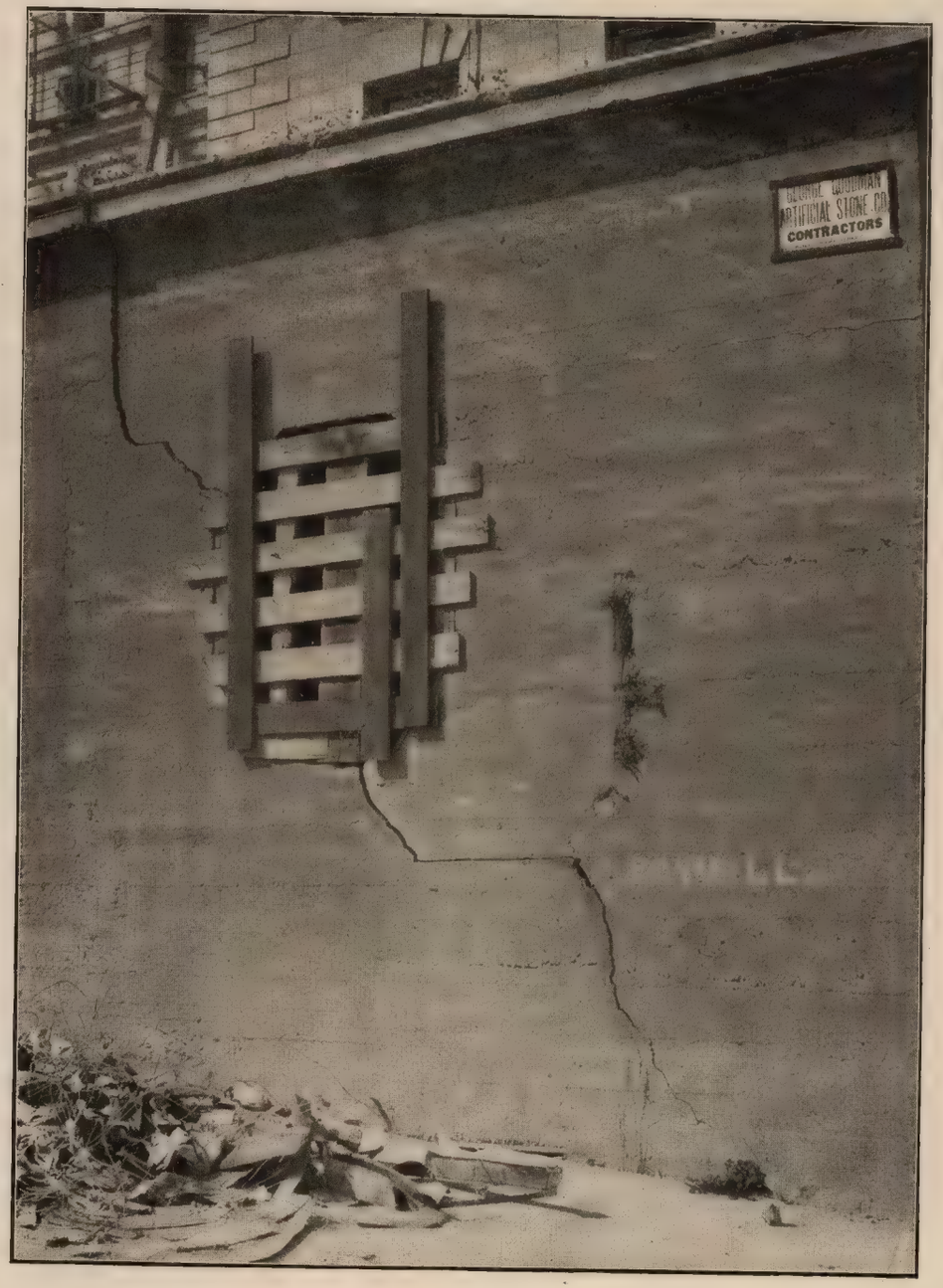
Buildings in the same vicinity that had been constructed on the same rocky foundations were but slightly damaged—in many cases even high chimneys were neither cracked nor broken.

Concrete Observatory

Another view at close range, showing the system of reinforcement. This collapse was due wholly to earthquake.

Fairmont Hotel

One story annex on Powell street side, constructed entirely of concrete 26 inches thick.
Showing shrinkage and earthquake cracks.



Fairmont Hotel, Monolithic Foundation

Earthquake cracks in the concrete wall appeared every few feet in the length of the building. The cracks started at the bottom and extended up to the line of the brickwork, where they stopped. This wall was more than 30 inches thick, and made from an excellent quality of cement and broken rock.

Callaghan Estate Building

Four inches of concrete fireproofing which was supposed to have fire-resisting qualities.

Reinforced Concrete Floors, Academy of Science Building

Showing the buckling of reinforcing bars, which caused sluffing off of concrete.

Reinforced Concrete Floors, Johnsen Building

Note the condition of reinforced concrete and expanded metal lath ceiling after an actual test; also the perfect condition of the brickwork in the background.

Reinforced Concrete Floors and Concrete Fireproofing

Did it stand the test?
(Total wreck.)

Bekins Van and Storage Building
Reinforced Concrete Floors

This building was in course of construction and unoccupied at time of fire.

Temperature could not have been very high, as lumber in interior was only slightly charred.

Note buckling of twisted bars, caused by expansion of same; also porous condition of burned concrete in ceiling—also the posts supporting floors.

Reinforced Concrete Building at Powell and Sutter Streets

Showing effect of fire. Was once the pride of the owner and architect.

Do concrete and steel contract and expand together?

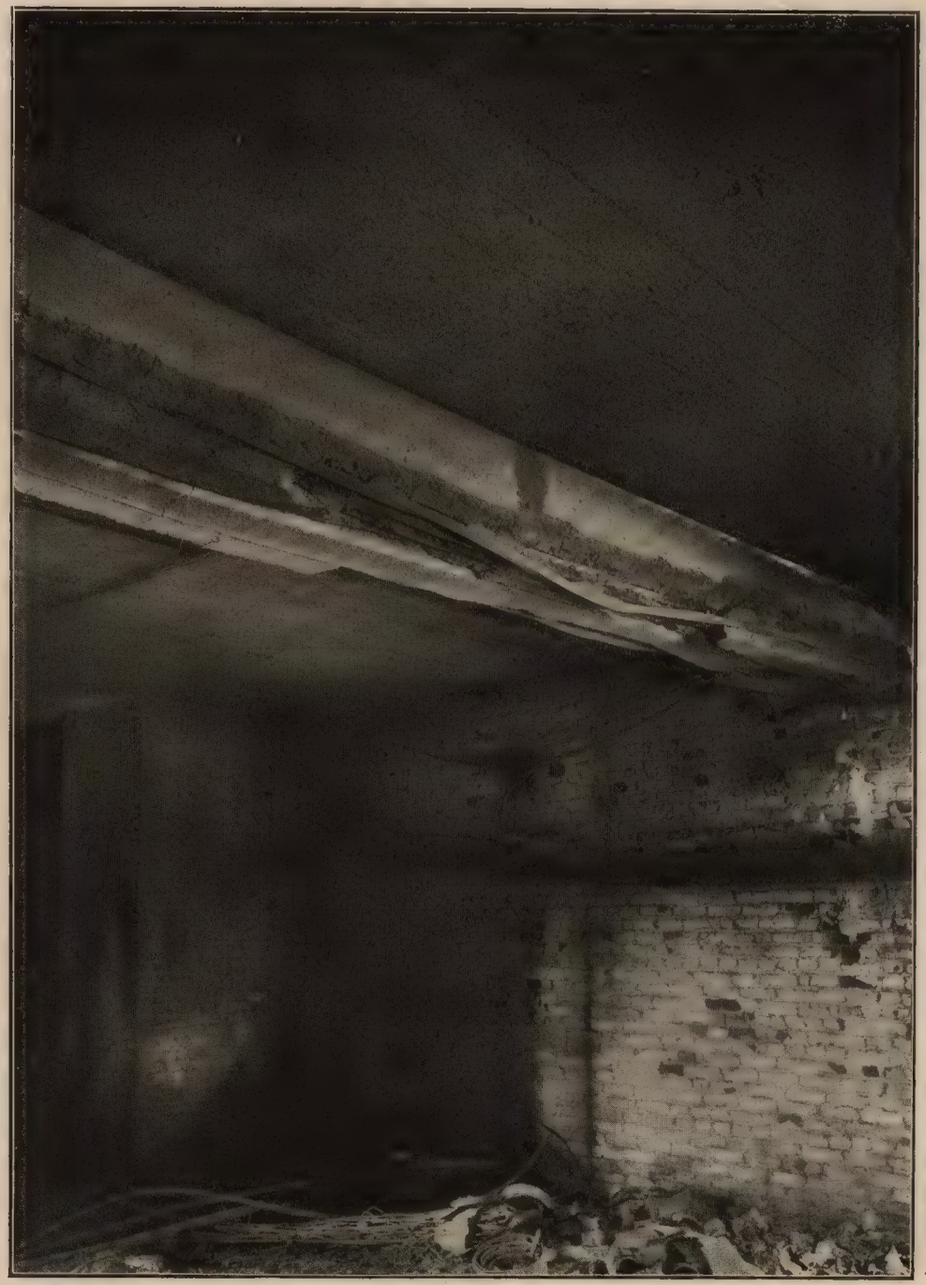
Note unburned condition of timber in basement.

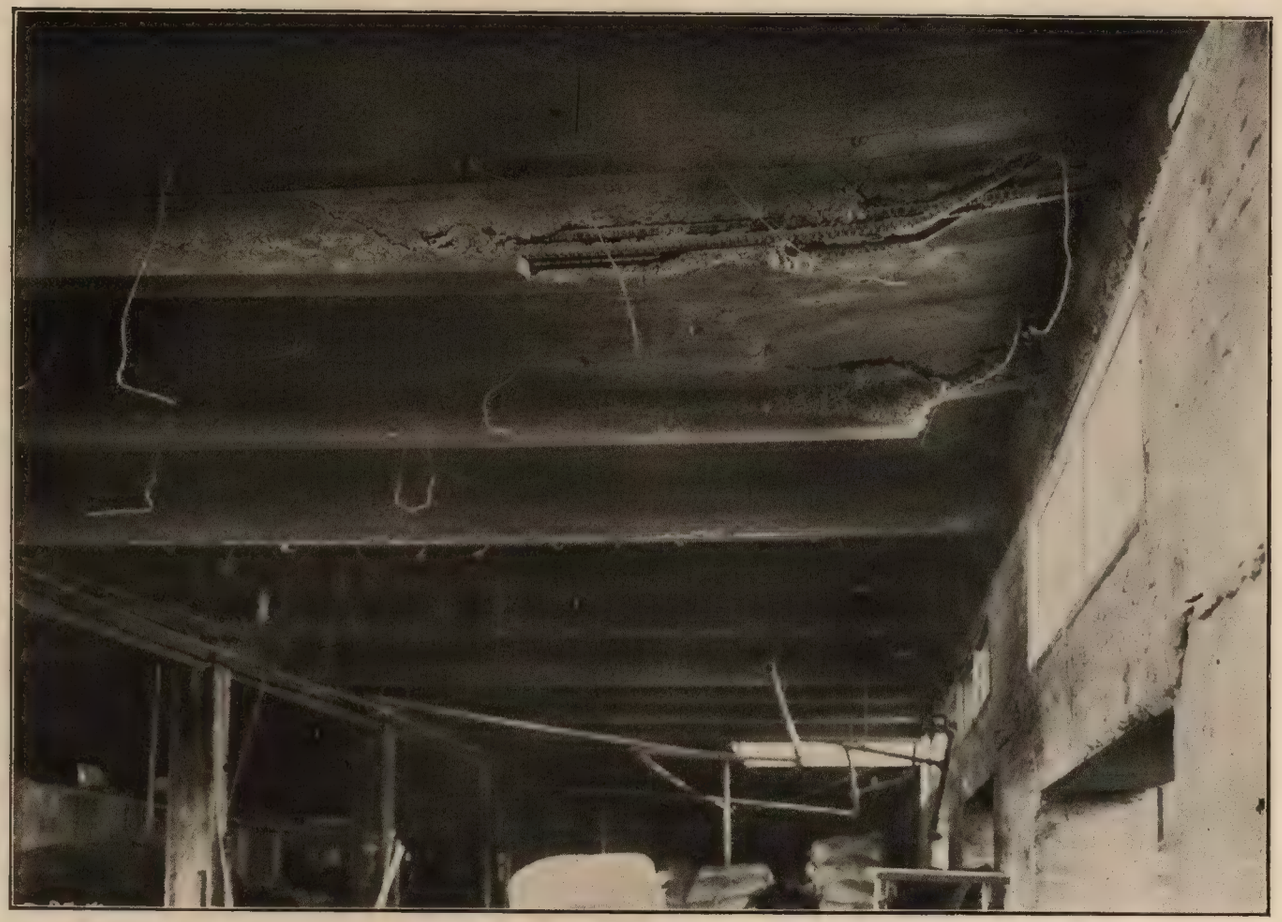
Academy of Sciences Building

Reinforced concrete under fire. The buckled condition of the bars in this girder disprove the teaching of reinforced concrete engineers—that concrete and steel expand and contract together.

The present condition of twisted bar reinforcements show plainly that the steel expands under heat and separates itself from the concrete.

From the effects of fire in this building the concrete floors were all badly wrecked and will have to be removed.





Monadnock Building

Reinforced concrete beams under actual test. In this building the best formula for reinforced concrete construction was used. Note Johnson bar, which had been turned up at ends to resist shear strains. The pile of unburnt sacks that are seen indicate that these girders were subjected to very little heat, having been destroyed by action of the quake.

Monadnock Building

Destroyed reinforced concrete girders. The claim of reinforced concrete engineers of the adhesiveness of concrete to steel is here disproved. Note bars which remain straight and unbroken and clean of the concrete.

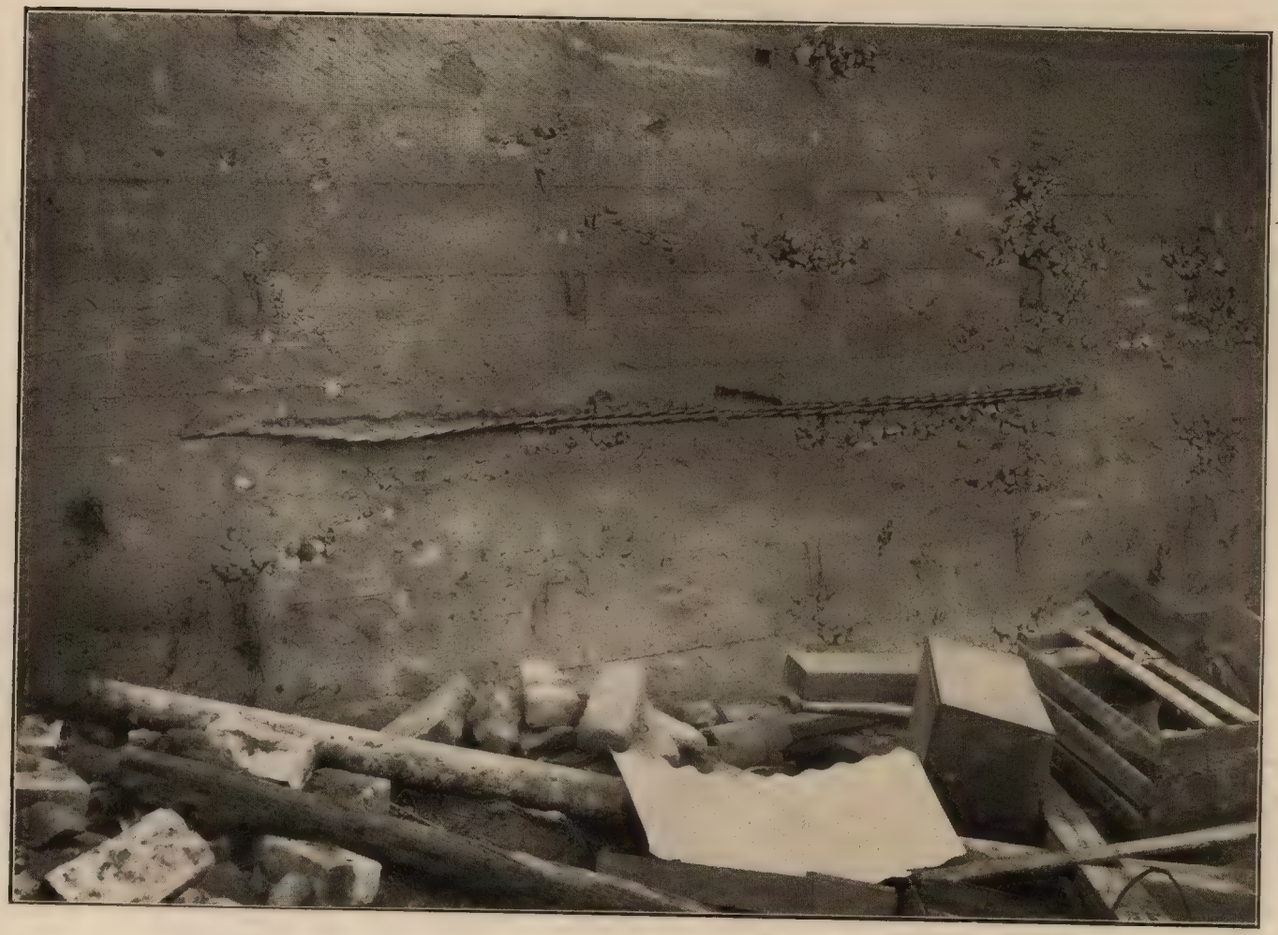
According to the theoretical teachings these bars embedded in concrete should have sheared or broken.

Does it pay to experiment with an unknown quantity?

Reinforced Concrete or Monolithic Construction

Building on Francisco street, between Stockton and Dupont streets.

This picture, with the accompanying ones, will no doubt be very interesting to those who retain the impression that there was no genuine reinforced concrete or Monolithic construction in San Francisco previous to the earthquake and fire.



Side Wall of Same Building Shown in the Preceding Picture

Note behavior of twisted steel bar under action of heat, it having expanded, forcing its way through its concrete covering. The unburned pieces of 4x4 lumber lying near is evidence that the heat was not very severe.

Showing Side Wall of Same Structure

The many perpendicular cracks in the wall indicate that concrete and steel do not expand and contract together under heat, steel expanding at a much greater ratio than concrete; therefore cracks appeared. Note disintegrated condition of concrete near opening, caused by fire.

At Stanford University, Palo Alto. Museum Building

Has the entire truth been told and shown about the effects of the earthquake upon the different forms of construction?

The name of Ransome appears on a name-plate imbedded in the wall of this building as designer of the system used.

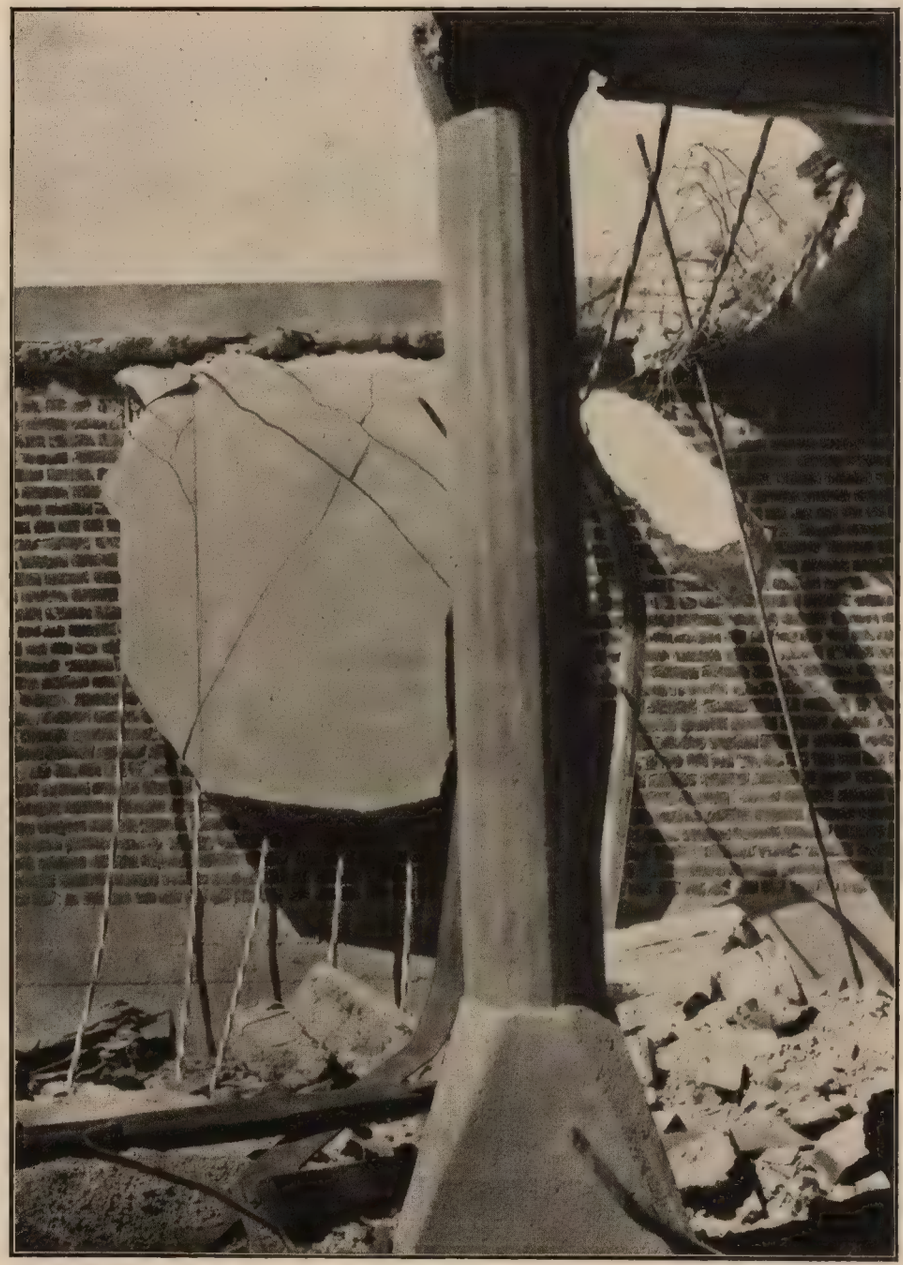
The camera shows many twisted bars scattered over and near this wreck. They are perfectly clear and clean of cement, thus proving conclusively that the boasted adhesiveness of steel and concrete in reinforced concrete construction does not exist.

Twisted Bars

Pile of reinforcements after collapse at Palo Alto. If there exists any adhesion of concrete to steel bars these bars fail to show it.

Interior of Museum Building, Stanford University

Column and floor construction, showing effect of earthquake. Note perfect condition of brick wall.

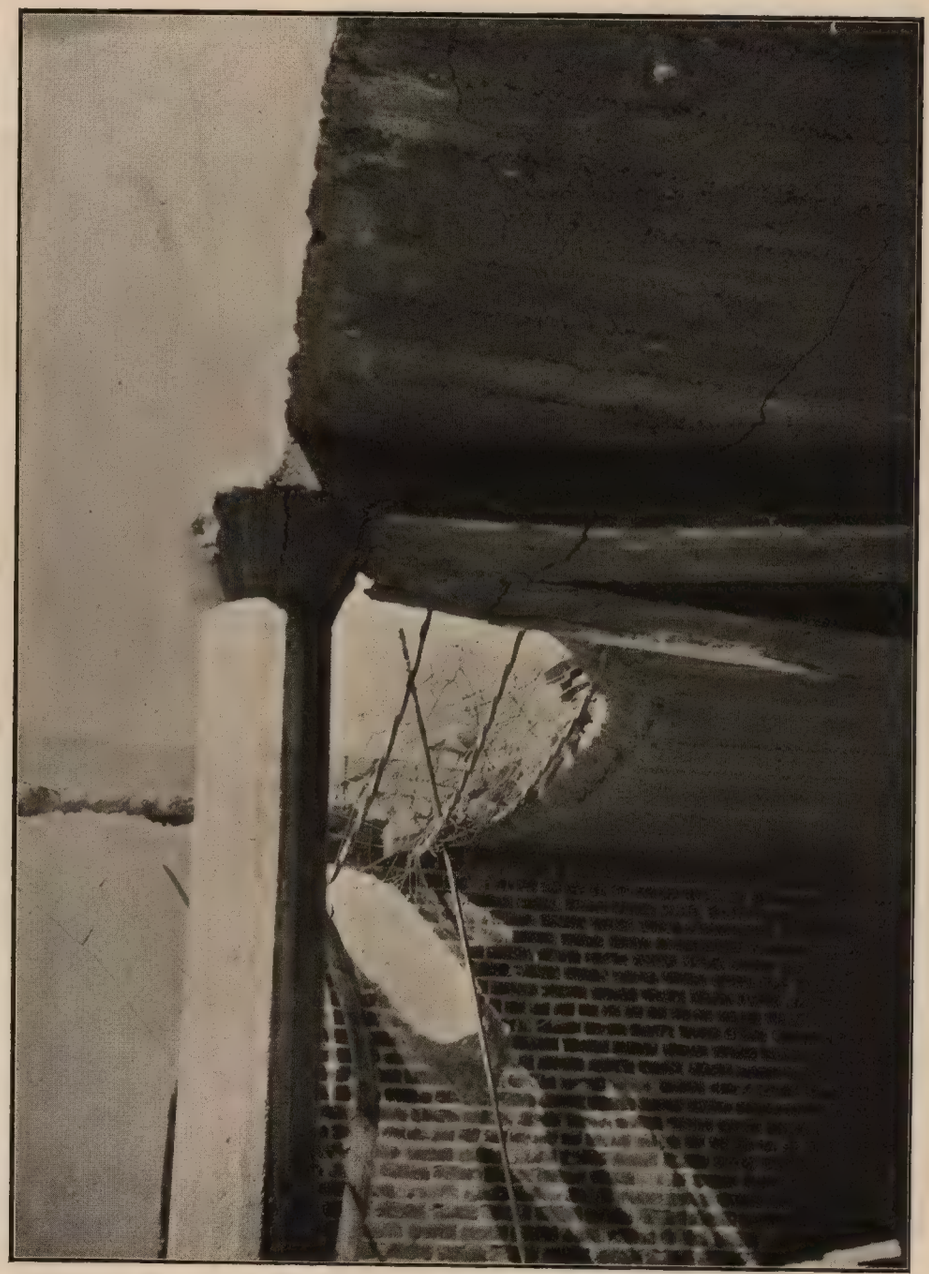


Interior of Museum Building at Stanford University

Showing the damage done to brick wall by the collapse of reinforced floor. The wall remains standing, except where floor forced the brick outward. In proof of this note the condition of broken wall, which is bent outwardly by the force from within.

Interior of Museum Building
at Stanford University

Showing column, floor and girder construction.



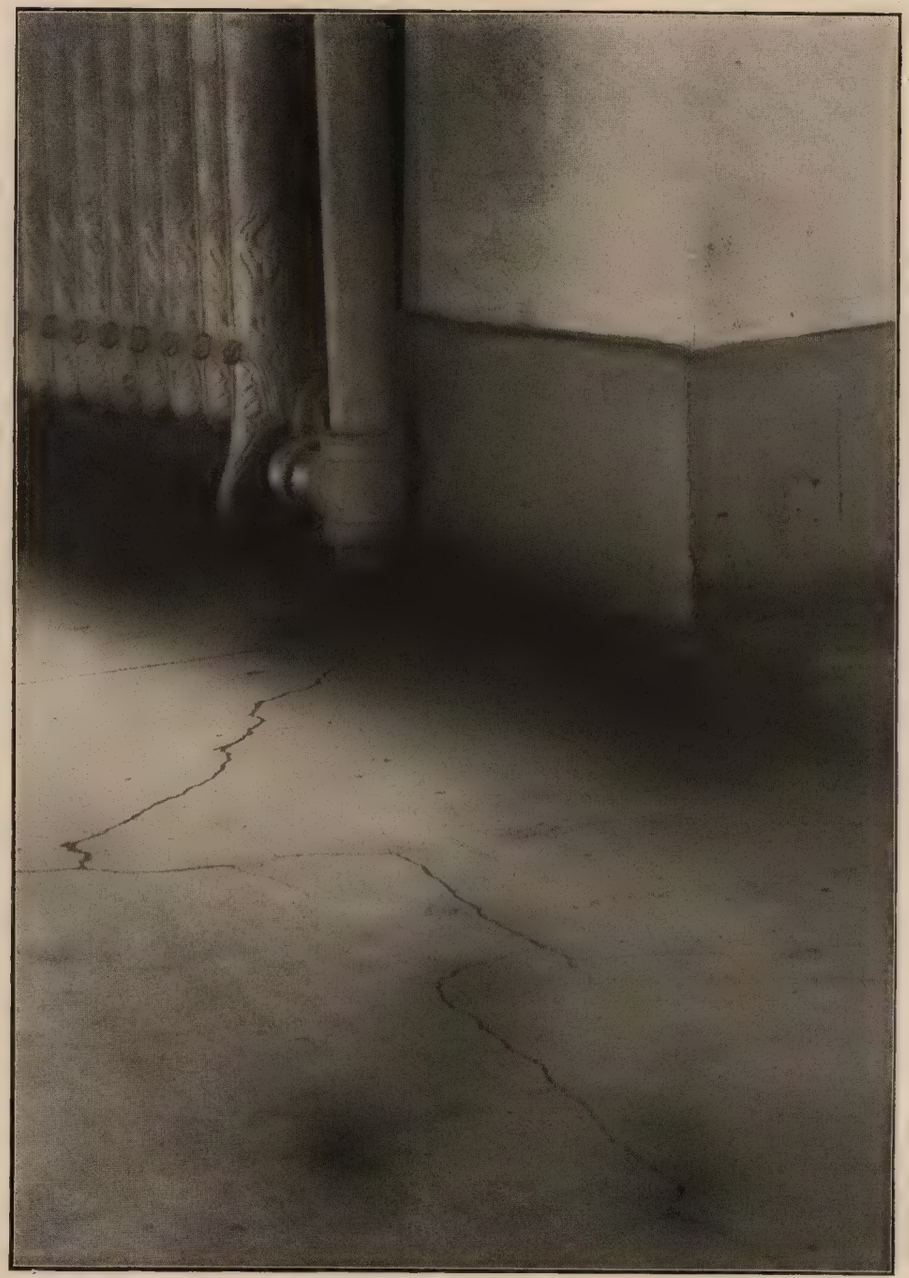
Interior of Museum Building, Stanford University

Monolithic floors, Ransome system. Note the perfect condition of brick walls, especially the small brick arch; also the breaking line of the floor.

Reinforced Concrete Building, Los Angeles, Cal.

ERECTED BY HOMER LAUGHLIN

This was one of the first of the monolithic structures erected in Los Angeles. The name of the owner is significant that the best form of construction known to concrete engineers and the best material that could be procured was used. Nevertheless since the cement commenced to age and shrink, as it must do in order to crystallize and harden, many of these cracks have appeared, and the owner has asked for an investigation. This building houses the Public Library.



Reinforced Concrete —Interior View, Homer Laughlin Building

ROOF GARDEN SAID TO BE UNSAFE.

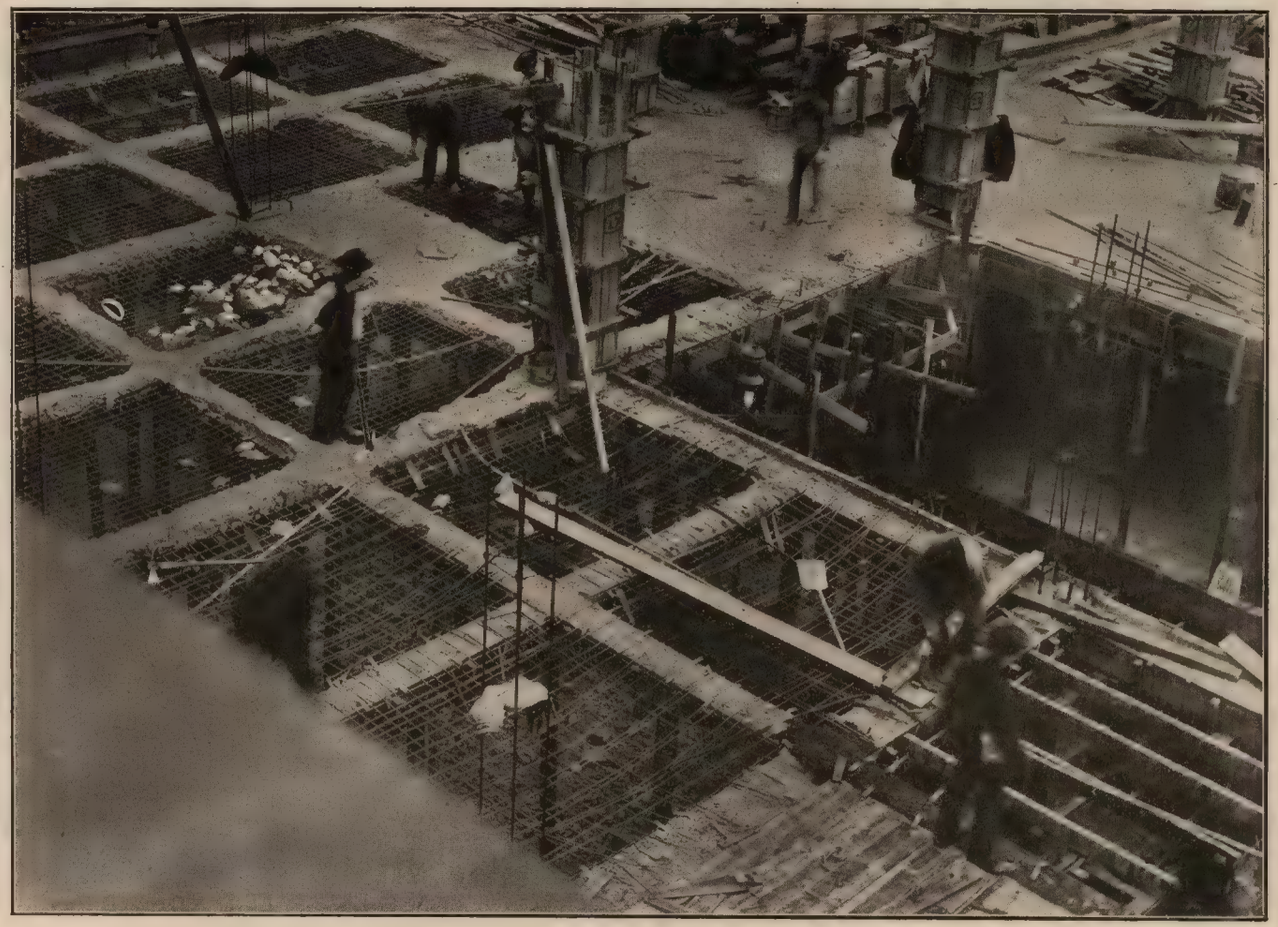
Open Air Reading Room at Public Library May Be Abolished.

The Los Angeles Examiner of Dec. 29, 1906, says under the above heading:

"The unique roof garden reading room of the Public Library, which has proved so popular to the thousands who enjoy the fresh air and sun baths of Los Angeles while they study and read, is threatened with abolition.

"The weight on the roof of the concrete fountain, the vine trellises, tables, chairs, and people is declared to be too much for the roof in the complaint sent in by Homer Laughlin, owner of the building, to the Library Board.

"Building Superintendent J. J. Backus has been asked to make an inspection of the roof garden and building to try to save the roof garden to the public."



Reinforced Concrete Building

Corner of Third and Main streets, Los Angeles.
Tearing out defective material. Was it all removed? Time alone will tell.

Hotel Bixby Disaster, Long Beach, California

Friday Morning, November 9th, 1906

Los Angeles Times, July 25, 1907.

Big Verdict Appalls

Jury's Award in Bixby Hotel Case Causes Alarm among Architects and Owners

Architects and owners of buildings exhibited great concern yesterday in the verdict of a jury in the Superior Court Tuesday, by which Mrs. Jewett E. Phillips was awarded $10,000 damages for the death of her husband, a workman employed on the Hotel Bixby at Long Beach, who was killed when that structure collapsed last November, carrying twelve men to death and causing injuries to a dozen more.

Aside from the fact that the Long Beach Hotel Company, * * * owners of the building, are called upon to pay this award, and may have to pay many more of like amount, owners and architects are apprehensive lest this case may be taken as a precedent, and that in the future they will be held responsible for similar accidents.

It is said that the Phillips case will be carried to the highest court by the defendants, who still hope to have the verdict set aside. If they fail, it is believed that numerous other suits will be filed in connection with the Bixby disaster. With this $10,000 verdict as a guide, the amount of damages to be paid by the defendants will run far above $100,000, and may reach double that amount.

The blame fixed upon the owners in the Phillips verdict may be taken as laying the foundation for criminal prosecution.

F. L. Spaulding, contractor on the building, was not named in the complaint, and is not involved in the payment of damages.

Collapse of the Bixby Hotel at Long Beach, Cal.

Five-story reinforced concrete structure. This building collapsed without giving a minute's warning. The workmen were caught totally unawares.

The Hotel Bixby Disaster

Official Report of Committee Declaring that Catastrophe resulted from a Lack of Bond between Concrete and Steel—Contractor Exonerated

From the San Francisco Examiner, November 22, 1906.

The committee appointed by the State Conference of the Bricklayers and Masons' International Union to investigate the cause of the collapse of the Bixby Hotel reinforced concrete building at Long Beach, November 9th, where twelve men were killed, made its report last night to the local Bricklayers' Union, which was adopted. The following is the conclusion of the committee:

To the Executive Board of California State Conference, B. & M. I. U.

Brothers:—We, the committee appointed by the State Conference fourth annual convention, held at Bakersfield, November 12th, 1906, to make report on collapse of Hotel Bixby at Long Beach, beg to make the following report:

We find that the concrete and reinforcement used to have been A1 material. Concrete was excellent, the mixture having been according to specifications, 1 to 5, hard flint volcanic rock having been used in the aggregate. The steel used in the reinforcement of the concrete was chiefly the Kahn bars, recognized among reinforced concrete engineers as being the best and highest price reinforcement on the market, though Ransome twisted bars and square and round bars were used in columns and in some parts of the building.

The main support or foundation was pier construction, going down at least ten feet below the surface, piers resting on a bed of sand that had been found, after a three months' test, to be sufficiently solid to carry the contemplated load.

A provision had been made, in part of the exterior columns, to take care of any settlement that might take place on any one pier, by connecting them together at about the surface line with a reinforced girder, assuming that this would act as a cantilever, and hold from settling any one pier or piers. We failed, after a careful examination, to note any settlement in such piers or foundations.

Bixby Hotel, Long Beach, Cal.

General view showing fractured columns and girders.

Read the accompanying report.

UP-TO-DATE MATERIALS USED.

We also found, and it is not disputed, that the columns, girders, floors and curtain walls and the entire building was constructed according to the best formulae used by up-to-date reinforced concrete engineers; that the contractor, F. L. Spaulding, is a practical and conscientious reinforced concrete contractor, having handled concrete in its best forms in building construction for the past 25 years, and he accorded us every opportunity to make a careful inspection.

We found, after examining the testimony of those who were sworn at the coroner's inquest, that the most logical conclusion taking the testimony of the contractor, F. L. Spaulding, was expressed in the language of his superintendent, William Behm, who, with him, was standing on one of the top floors, and exclaimed, "My God, something is breaking underneath!"

They both testified that the failure was near the ground floor, and as it went down it pulled the upper structure with it, proving by the sworn statements, not alone by themselves, but by others, that the top floor sunk in like a bowl.

And, also, after careful examination of the ruins, the way the debris was piled up, we, the committee, coincide with his statement, that something near the ground floor gave way.

L

REINFORCED CONCRETE FAULTY.

After an examination by us, to discern the true cause of the collapse from an unprejudiced standpoint, we are a unit in the belief that there existed certain defects, namely, that in reinforced concrete construction, there is no natural adhesion or bond between concrete and steel. Our proof of this can be substantiated by examining the accompanying photographs, showing where the reinforcements were pulled out, stripped from the concrete, and can be plainly seen lying at the bottom in a tangled mass mixed with the debris, and in some places hanging from the shattered columns and girders like so many ropes dangling in the air, clear and clean, and without the slightest trace of any cement ever having adhered to it, thus disproving the claim of reinforced concrete engineers that there is a natural adhesion or bond between concrete and steel.

The photographs will also show that the shear in concrete is practically nothing.

Another defect, and no doubt the most important of all, perhaps the one causing the loss of so many lives of our tradesmen, was the column construction. Though it had been built according to the best formulae, and designed to carry five times the weight

Bixby Hotel, Long Beach, Cal.

The two stumps of columns in background are supposed to have been the ones which caused the disaster. They crushed under the imposed load.

required in this particular building, the accompanying photograph will show from the cone-shaped appearance of columns at the point of breaking, that the failure was caused by spalling or crumbling. The reinforcements of such columns were buckled outwardly from the center, proving conclusively that columns were crushed from the imposed load, and as the columns crushed and came down, it being monolithic construction, the floors, columns and girders above followed them down.

Careful estimates made on these reinforced columns show that the dead or imposed load did not exceed more than 500 pounds per square inch. They having been constructed to withstand more than 2000 pounds, ultimate strength, or with a safety factor of four, and as 500 pounds was all the columns were carrying, it is a fair conclusion to say that the material of which they were composed, 1 to 5 mixture, though well reinforced, when used in monolithic construction, will crush at 500 pounds per square inch, ultimate, disproving the theoretical or laboratory tests when put to practical use.

NOT DUE TO HOLLOW TILE.

As to the unwarranted claim of some that the collapse was due to the hollow tile used, will say that your committee, after making careful and thorough examination, found that the tile were carrying no load whatever, and were simply used for a filler and for exterior curtain walls which were carried on concrete girders at each story the same as on steel frame construction, the building being what is known in Los Angeles as a Class A building, where loads are transmitted by the girders to columns, the wall in between carrying no weight whatever, but being of tile, thereby materially lessening the load being carried on columns.

We find that one of the most dangerous points in reinforced concrete construction is at the angles, there being no known method of overcoming the weakness at this point.

We find that 10 or more people were killed and many maimed and injured for life.

Accompanying this report will be samples of cement and stone; also concrete and reinforcements used in building.

Submitted most respectfully,

RICHARD H. HOPKINS,
JAMES RINGROSE,
HENRY SCHOTT,
EDWARD A. GERETY,
FRED A. GATES.

Bixby Hotel, Long Beach, Cal.

Searching for the dead and wounded.

Bixby Hotel, Long Beach, Cal.

Built of reinforced concrete. L

Removing the dead and wounded. Ten or more people were killed outright, and many injured and maimed for life. L

Bixby Hotel, Long Beach, Cal.

Showing the point of failure in reinforced concrete column.
Note pile of reinforcements.

Bixby Hotel, Long Beach, Cal.

Two hours after the collapse, showing the manner in which the debris was piled up.

Reinforced Concrete Bridge, South Pasadena, Cal.

Condition about one year after erection. Note supports under center portion of bridge. Failure appearing in numerous places has made the bridge unsafe.

Reinforced Concrete Bridge

Cracks similar to one shown appear on top of arches.

Reinforced Concrete Bridge

Showing failure of side wall and roadway.

Reinforced Concrete Bridge

Side wall showing reinforcements. An attempt was made to patch the cracks (note lines on cement) when they first appeared, but failure in concrete cannot be successfully patched, as picture shows.

Reinforced Concrete Bridge

Vertical crack in abutment. This same crack also appears on the other side of bridge.

Bridgeman Bros. Building, Philadelphia, Pa.

Reinforced concrete. Searching for dead and wounded. Collapsed Wednesday, July 10, 1907. Four men were killed and twenty injured.

Bridgeman Bros. Building, Philadelphia, Pa.

Editorial *Philadelphia Press*, Thursday, July 11.

THE CONCRETE COLLAPSE.

The lamentable collapse yesterday of reinforced concrete in a building at Fifteenth and Washington avenue appears to be due neither to weakness of construction nor to mistakes in plan.

Day laborers were employed where skilled mechanics were demanded, and they, it is reported, took out all the supports of the flooring when only every other one should be removed. Whether the evidence at the inquest sustains this report or not everyone familiar with reinforced concrete construction knows that it is not as easy as it looks.

On the surface, unskilled labor and very moderate skill in superintendence seem equal to the apparently simple task of pouring concrete into molds and about wire netting and steel bars and beams. As a matter of fact, until the concrete has set the risks of error are considerable, and the weights are so great and so rapidly put in place that it is easy to underestimate strains and to anticipate the limit of safety in removing supports. The concrete wall or floor may look solid, when as a matter of fact, it is not able to bear its own weight.

Our building laws and regulations are well provided with specifications as to the strains of reinforced concrete, the reinforcement required and the margin of safety. They have not sufficiently provided for safe methods of construction. A serious accident like that of yesterday, with its list of killed and wounded, impresses the necessity of not leaving the removal of supports in concrete construction to the mere judgment of a man in charge of a building or to the day laborers, to whom he gives verbal directions, when, if a mistake is made, it means disaster, death and maimed men.

"Reinforced Concrete"

The Ghost of the Concrete Collapse Rises Again.

F. W. Fitzpatrick, Executive Officer of the International Society of Building Commissioners, in Fireproof Magazine for January, 1907, says:

"There is so much else of real live interest for us to talk about that I had not intended to touch upon concrete fireproofing, this month at least, but it comes prancing to the middle of the stage again, compels the limelight to be turned full upon it and clamors for our undivided attention; not on account of anything wonderful that it has achieved, but, as it so often happens, it forces attention because of its misdemeanors, or rather on account of the negligence, the criminal culpability, the ignorance, of its votaries and the uncontrollable greed of its producers."

"In but a little over thirty days this is the record that forces itself upon our attention: A fatal collapse at Elyria, Ohio; another at Mineola, L. I.; still another at Rochester, N. Y., and a still worse one at Long Beach, Cal. A score of lives destroyed and as many more workmen seriously injured. Besides these there was the collapse of a 200-foot concrete chimney at Peoria, Ill., a barely averted collapse at Los Angeles and a still narrower escape in Montreal."

"The story of these collapses reads strangely like those that are on record comparatively recently at Bern, Switzerland, and Paris, France; Trenton, N. J., Newcastle, Pa., Milwaukee, Wis., Duluth, Minn., Dayton, Ohio, Pittsburg, Pa., Greenpoint, N. Y., Marshall, Ill., La Crosse, Wis., Binghamton, N. Y., Corning, N. Y., Boston, Mass., and again at Trenton, N. J. Faulty design, negligent supervision, indifferent materials and criminal haste in removing centering are the concomitants. The worst of it all is that we realize that as long as the average man's conscience is constituted as it is today, and that kind of work is permitted, just so long will we have to chronicle just the same kind of disaster."

"To people who are on the verge of allowing themselves to be persuaded that concrete construction is cheap, the photographs of the ruined Bixby Hotel at Long Beach, Cal., ought to be a potent deterrent, a powerful antidote; to those who have almost been convinced by talk that reinforced concrete construction was fireproof, the photographs

Bridgeman Brothers Building

Mass of fallen concrete.

of the so-called concrete buildings in San Francisco, after passing through the fire, should convict the convincers of at least MISREPRESENTATION, to use a very nice and polite term. The evidence of the camera carries infinitely more weight than mere verbal statements and flowery promises.

"The matter of concrete collapses and general misbehavior is of considerable importance, no laughing affair. Yet one phase of it is somewhat amusing to me, personally, at least. Early in 1900, when the symptoms of the reinforced concrete craze were first developed, I was asked to define my position towards it, and stated that 'For many purposes it is a most admirable material, but at the same time it is the most treacherous material we have, the one about which least is known, and one that will be most carelessly used and generally by incompetent workmen at that. As a fireproofing material it is overestimated; structurally it is capable of the highest development, but is surrounded by so many difficulties that I would as lief handle dynamite as work with concrete in floors and other constructions where the minimum quantity is a factor, and where to a certain extent dependence is placed upon it as a material to resist transverse strains.

" 'Each of its ingredients must be just so; the amount of water used makes or mars it; its tamping is a scientific process; its designing requires the greatest skill, and it should be made and mixed and placed not only under the superintendence of, but actually by, a skilled and experienced worker. In floor construction of large units the slightest flaw vitiates the whole span; it is like a chain, whose greatest strength is its weakest link. It requires considerable time to set properly, and does not acquire carrying qualities for months after it is actually set; the materials with which it is made are subject to all sorts of variations, so that there can be no certainty about it. It is an unknown quantity. . . . And the one certain result that will follow its promiscuous use will be the actual collapse, the crumbling of many structures, even while under construction.'

"I was jumped on, assailed from every side. And it is a source, not necessarily of gratification, but of amusement, to compare those old utterances with some of the statements now being made by the same high authorities since the last few collapses. Their new conservatism is refreshing, and if nothing switches them off the track, they will soon out-Herod Herod in their denunciation of the slipshod construction. It would be sinful to mention any names, for it might stop some of the good work, but it may not be amiss to quote from a few others than those I have particularly in mind; authorities, too, who may at times have clamored loudly for 'concrete at any price and for all purposes,' though as a rule these last from the first have called for caution and reasonable discretion in handling a most ticklish material:

Bridgeman Bros. Building

Philadelphia Enquirer, July 11.

Says Work Was Defective.

John Clark, of 1218 Cabot street, superintendent of cement finishers, who was at work on the second floor when the crash came, stated it as his belief that the accident was caused by defective concrete work on the fourth or top floor of the building. He said: "The concrete of the fourth floor was put into place two weeks ago, and the concrete itself was of sufficiently good material, but was not treated properly after it was put into place.

"For concrete to become properly 'set' it should be thoroughly wetted every morning for at least four days. I am not aware that the concrete on that top floor was wetted after it was put in except by the rain, which was insufficient. Its exposure to the sun, too, caused it to dry out with extra quickness. The effect of this premature drying caused the concrete to shrink from the supporting rods; it didn't have the proper 'grip,' and the consequence was that when the supports were knocked away this morning the floor collapsed of its own weight."

Hotel Bixby

At the trial brought by Jewett E. Phillips, et. al., for the death of L. N. Phillips, her husband, one of the victims of the Bixby Hotel disaster, evidence was introduced to show that the columns above the second floor were overloaded. Columns on the third floor were constructed according to plans and specifications—10" by 10" 9 ft. high, reinforced with four ½-inch round rods, and were carrying 90,000 pounds. Evidence was also introduced that in some cases where plans and specifications called for columns 8" x 8" they were constructed 10" x 10".

"*The Engineering News,* commenting on the late collapses, says: 'The practice that constructs buildings and bridges that collapse must be eradicated. . . . It is indeed time to call a halt. . . . The public is observing that alarming numbers of failures of reinforced concrete work are recorded in the news of the day. It learns vaguely that each of these failures has been blamed upon improper workmanship, or disobedience of workmen, and upon scanty design or design unsuitable of safe execution by the grade of labor employed for the work. These observed facts impel the lay reader to one definite conclusion: That reinforced concrete is a dangerous building material. Dangerous for unknown reasons, among which may be these: Either (1) because safe methods of design have not yet developed, or (2) because the commercially obtainable materials of construction are subject to unknown variations which may produce fatal weakness, or (3) because the quality of labor employed is not high enough to insure the safe construction of the design, even though the design and the material be satisfactory. To this conclusion we are regretfully forced to subscribe. . . .

"*The American Architect,* looked upon by most architects as a sort of a Bible or Testament, says: The lengthening roll of disaster involved in the attempt to use reinforced concrete had another item added to it last week, when a large part of the Bixby Hotel at Long Beach collapsed, killing nine of the workmen and seriously injuring as many more. . . . The argument, so attractive to investors, that cost can be reduced through the employment of 'cheap labor' is to some degree fallacious, as many a man has felt within the last year or two, as he gazed at his useless heap of reinforced concrete debris. The owner who, in these times, when there are few architects, engineers or builders who can claim to have had any real experience in concrete building, puts a time limit in to his contract, enforceable with a penalty, is quite likely to have serious cause for regret."

"To me the most impressive pronunciamento of all is a letter I received a few days ago from a really able government engineer, a man who has been looked upon by the concrete people as a sort of Moses, one who has done perhaps more than any other in having the United States government use as much concrete construction as it has of late. He was never very wordy, but his statements are generally quite clear. Touching upon concrete, he writes me: 'So many concrete things are falling down lately that something will have to be done to insure better material, proper design and less stealing; otherwise concrete buildings will be regarded as a makeshift at best, and I, for one, value my reputation too highly to have much more to do with that form of construction under existing conditions. . . .'"

Bridgeman Bros. Building

Editorial *The Philadelphia Enquirer*, Thursday, July 11.

WHO IS RESPONSIBLE FOR THIS TRAGEDY?

Yesterday afternoon a building in course of erection on Fifteenth street, below Washington avenue, crashed to the ground, burying more than two score workmen in the ruins.

Several lives were lost, and in many more instances injuries were inflicted which may prove fatal or which may result in permanent disablement.

No such shocking disaster has happened here for years and the circumstances under which it occurred must be made the subject of a searching and unsparing investigation.

It was not an accident. Buildings which are being constructed under proper conditions, under the conditions which an intelligent and vigilant inspection will always ensure, don't collapse in a moment without warning like a house of cards.

There must have been negligence, there may have been worse than negligence, somewhere, and it will be the duty of the city authorities to ascertain the facts and to place the responsibility where it belongs.

What do we have building inspectors for, if it is not to prevent just such a catastrophe as this?

The public will not be satisfied, and it should not be satisfied, until the accountability for an occurrence which bears the aspect of a crime shall have been fixed upon those to whose guilty incompetency or guilty carelessness it is attributable.

So far as can be seen now it is a case of jail for someone.

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